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China Pours Money into Smart Grid Technology

Beijing Upgrades Smart Grid Development to Strategic National Priority, Challenging the United States

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Introduction

There is no way to get around this fact—China aims to modernize its energy infrastructure at home and dominate clean energy technology markets abroad. At the 2011 Smart Grid World Forum in Beijing late last month, China's State Grid Corporation announced plans to invest $250 billion in electric power infrastructure upgrades over the next five years, of which $45 billion is earmarked for smart grid technologies.[1] According to its three-stage plan, China will invest another $240 billion between 2016 and 2020 (including another $45 billion toward smart grid technologies) to complete the build-out of a "stronger, smarter" Chinese power grid.

When complete, this system will improve energy efficiency, lower carbon emissions, and give Chinese consumers more control over their utility bills. Chinese leaders are betting that upgrading to a smarter electricity grid will also drive technology innovation and move the country up the manufacturing value chain. The Chinese view smart grid technology as the next industrial revolution—and they want to make sure that once other countries start upgrading their own grids, they will buy most of their equipment from China.

This issue brief details why the United States should take note of China's ambitions and step up our own smart grid efforts. We, too, need a stronger, smarter electricity grid, and in many smart grid sectors, our enterprises are already producing the best technologies. All they need is a bit more policy support at home to speed up interoperability, to drive down equipment prices, and to ensure the smart grid revolution will be a market driver not only for China but also for the United States both at home and in export markets abroad.

What is a smart grid and why does China need one?

The main difference between a smart grid and a conventional grid is that smart grid components (similar to smartphones) are upgraded to include sensors, computers, and a wireless interface. That means the bits and pieces of the electric grid—the transmission wires, transformers, distribution wires, and usage meters—transmit and distribute electricity more efficiently and reliably to end users, and they can also report back on how that process is going and adjust operations along the line to fit changing conditions.

This smart functionality is critical for integrating key elements of a clean energy future, such as renewable power generation and electric vehicles. Unlike traditional coal-fired power, renewable power can be decentralized (multiple wind farms instead of one massive coal-fired power plant) and is often weather dependent. Conventional grid systems are designed to transfer a steady and predictable flow of power from point A to point B. When a thunderstorm reduces solar panel output or increases wind turbine output, those power fluctuations can trigger blackouts and burnouts in a conventional grid system. But a smarter grid can adjust, either by storing excess energy in batteries until it is needed or by moving power more efficiently across longer distances.

Smarter grids are also better at handling higher and more variable demand loads, and that will be critical when more electric vehicles are added to the system. Current consumer demand is very predictable, so utility companies know exactly what times of the day to purchase and distribute extra power to counteract daily peaks. Electric vehicles likely will not follow traditional consumption patterns—meaning demand peaks will be harder to anticipate—and that will create new operational challenges that will be hard to address without a more automated system.

The Chinese need more clean energy to meet their escalating electricity demand, and that will require a smarter grid. China is now the world's largest electricity consumer, and Chinese demand is expected to double over the next decade, and triple by 2035. Their current energy mix is heavily dependent on coal—around 70 percent of overall consumption in 2010—and coal supply and price fluctuations are threatening economic growth. In 2011, for example, coal shortages forced China's national economic planner, the National Development and Reform Commission, to begin rationing electricity in April, months ahead of the normal summer peak.

To comply with the rationing, officials in China's power-hungry industrial regions cut off power to small enterprises from 5:30 a.m. to 7:00 p.m. daily and to medium-sized enterprises every few days. This forced many small- and medium-sized companies to operate only at night or to rely on pricey gas-fired power generators to keep their businesses running.

The only way Chinese leaders can keep their economy growing at current rates is to bring in more renewable electricity onto their national grids. Their latest targets call for the coun-

try to increase renewable energy to 9.5 percent of overall consumption by 2015, and a smarter electricity grid will be critical for integrating those supplies into the system.

The Chinese are also grappling with a major geographic issue. Energy supplies are concentrated in the west (including coal, natural gas, hydropower, and large wind farms), but demand is concentrated in the east, which creates major transportation challenges. China's west-to-east grid infrastructure is already overloaded, so coal supplies are often shipped via rail and road. Problem is, transport bottlenecks are so bad that in 2010 coal trucks triggered a month-long traffic jam on the Beijing-Zhangjiakou highway.

To relieve congestion, the Chinese want to shift more west-to-east transport to the grid, so a large chunk of China's upcoming grid investments (around $78 billion out of the $250 billion mentioned above) will go toward cross-country ultra-high-voltage transmission lines.[2]

Killing two birds with one stone

China's international technology ambitions

As is the case throughout the green energy sector, Chinese leaders are betting that if they can roll out a smarter electricity grid before the United States, China can not only address their domestic energy challenges but also get a head start on technology standardization. And they see standardization as a critical step toward moving up the value chain and playing a stronger role in global technology markets.

China's electricity market is divided geographically. China's State Grid Corporation controls 88 percent of the country and serves more than 1 billion customers, and State Grid wants to leverage that position to become a global smart grid standard setter. Smart grid networks involve hundreds of new technologies, from wireless sensors and smart meters to high-voltage transmission technologies, electrical vehicle charging stations, and many others. State Grid is aiming to dominate many of those industries, not only in China but also abroad.

In June 2010 State Grid issued its own proprietary equipment standards for 22 different critical smart grid technology solutions.[3] Equipment manufacturers must abide by those proprietary standards to become State Grid vendors, and since State Grid is the biggest smart grid customer in the world, equipment manufacturers have a strong incentive to comply.

In most markets, equipment based on proprietary standards such as the ones State Grid would like to see developed for its forthcoming smart grid do not have good economies of scale because their equipment is expensive to produce and less competitive compared

to equipment based on global standards. State Grid is betting that the Chinese market is big enough (and they themselves control so much of it, including both transmission and distribution) that they can use their massive purchasing power to achieve economy of scale and drive down manufacturing prices on their own.

Then, once Chinese manufacturers (many of which are State Grid subsidiaries) are churning out competitively priced smart grid products, they can export those same products to overseas markets such as the United States—and if those products are based on State Grid proprietary standards and intellectual property, the company will profit from every unit sold.

It is not yet clear how strongly China's national leaders support State Grid's one-grid-to-rule-them-all technology ambitions. Some in China are calling for a new round of restructuring to make the market more competitive and to reduce State Grid's massive purchasing (and therefore standard-setting) power. China's National Development and Reform Commission recently called for a new round of trials to experiment with splitting up electricity transmission and distribution.[4] If they proceed with those reforms, that will take a big chunk of the market away from State Grid.

No matter how they divide the market at home, however, Chinese leaders have already elevated smart grid development to a strategic national priority.[5] Smart grid technologies are also considered a "strategic emerging industry." Overall, that means that whoever drives the market, whether it is State Grid acting alone or a more diversified group of Chinese enterprises, Chinese leaders will provide strong policy support, and China's massive domestic demand will ensure that the country becomes a major player in global technology markets.

Implications for U.S. competitiveness

China's aggressive smart grid plan poses problems and promise for the United States. On the one hand, U.S. companies currently have the most advanced smart grid technology across the value chain—technology that could create big opportunities in China. State Grid is already working with General Electric Co., Honeywell International Inc., IBM Corp., and other U.S. companies on joint standardization projects. If those projects go well then at least some of China's smart grid investments could go toward purchasing U.S. products and paying U.S. technology licensing fees.

On the other hand, China's indigenous innovation program calls for reducing the country's dependence on foreign technology to 30 percent or below (down from the current 50 percent). That program focuses particularly on strategic emerging industries such as the smart grid.[6] That means we should expect the Chinese to favor home-grown standards wherever they can, particularly when the foreign versions are more expensive.

That could make it harder for U.S. smart grid equipment and services to gain a foothold not only in China but also globally.

Where there are competing international standards, the Chinese will face trade sanctions if they adopt State Grid's proprietary, home-grown solutions as compulsory national standards and blatantly shut foreign technology out of their market. In mobile telecommunications, for example, China developed a home-grown 3G wireless standard but Chinese regulators had to recognize and issue domestic operating licenses for all of the major international standards, not just the home-grown technology. In the smart grid market, however, international standardization is moving rather slowly, particularly in the United States, and that gives China more leeway to adopt home-grown solutions as their national standards and to leverage their domestic buying power to drive down costs and promote those technology solutions abroad.

The United States should not aim to compete with the Chinese on electric infrastructure investment. State Grid's investment commitments are impressive but a lot of that spending will go toward catching the Chinese up to where the United States is now. Their grid infrastructure is less developed than ours, so it is inevitable that they will have to spend more, and it is inevitable that those expenditures will make China a very attractive market for smart grid equipment manufacturers and private investors.

One thing we can do to improve U.S. competitiveness is to speed up our own standardization program. Most U.S. smart grid solutions are not yet based on common standards. That means that just like the pre-interoperability computer era (when your desktop computer, monitor, keyboard, and printer would only work together if they were all from the same manufacturer), U.S. smart grid technologies are hard to mix and match, and that drives up prices and stifles competition.

The United States is working to improve interoperability but the process is very slow. China boasts only two utility companies but there are more than 3,000 in the United States, and those companies are not used to working together. Our utility regulators are also not used to dealing with technology standardization.

The federal government can speed up interoperability by playing a stronger coordinating role at the national level to help our state and local utility regulators move toward common standards and interoperable (and therefore cheaper) equipment. The United States has already figured out how to do this in telecommunications and information technology; we just need to apply the same lessons to the electricity sector.

One thing the Chinese get right is using policy signals to stimulate private investment, and that is something we can do in the United States as well.[7] When Chinese leaders included smart grid development in the 12th five-year plan and State Grid announced

its ambitious spending plans, those moves kicked off a new wave of private Chinese venture capital investments in their domestic smart grid technology companies.[8]

We can encourage more private investment in our own smart grid infrastructure and companies by sending stronger policy signals here in the United States. The American Recovery and Reinvestment Act of 2009 was a big step forward—that funding was the biggest driver of U.S. smart grid market development to date, and it also jump-started the U.S. standardization process. But more work is needed. We do not yet have a strong federal champion to coordinate the different policy and industry stakeholders working on smart grid technologies, and that coordination is particularly critical in this sector because these technologies cut across traditional regulatory and industry divides (power generation, electric utilities, telecommunications, and information technology).

We are also still working to fine-tune the existing investment incentives. Some U.S. telecom companies complain that the Recovery Act gives utility companies incentives to build out their own proprietary smart grid wireless communication networks instead of utilizing the existing wireless infrastructure, which is based on common standards and interoperable equipment. The more we utilize common standards and interoperable equipment, the more we can improve our economy of scale and lower production costs for U.S. manufacturers—and that will lower infrastructure costs here at home and make U.S. technology and equipment more attractive in overseas markets.

Our path to a stronger, smarter electricity grid is actually much easier than China's. Since our grid systems are already more advanced, we can target our investments toward developing and deploying the latest and greatest smart grid technologies instead of playing catch-up. That means our market can be a much stronger driver for technology innovation, and we can get more economic bang for every smart grid buck.

To take advantage of this lead, we should work toward clarifying our standard-setting process and removing existing policy bottlenecks to smart grid deployment. Then, like the Chinese, we can leverage a stronger, smarter grid to decrease our dependence on foreign oil, to drive innovation, to create jobs, and to give consumers new options for saving money on their utility bills.

Those are goals that we can all get behind.

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Endnotes

Note: All translations are the author's own.

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